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Dryer

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(54) **VERSATILE SYSTEM FOR MANIPULATION OF DENTAL APPLIANCES**

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Related U.S. Application Data

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(51) **Int. Cl.**[7] **A61C 3/14**
(52) **U.S. Cl.** **433/159**
(58) **Field of Search** 433/3, 4, 156, 433/153, 155, 159, 40, 141, 146, 162

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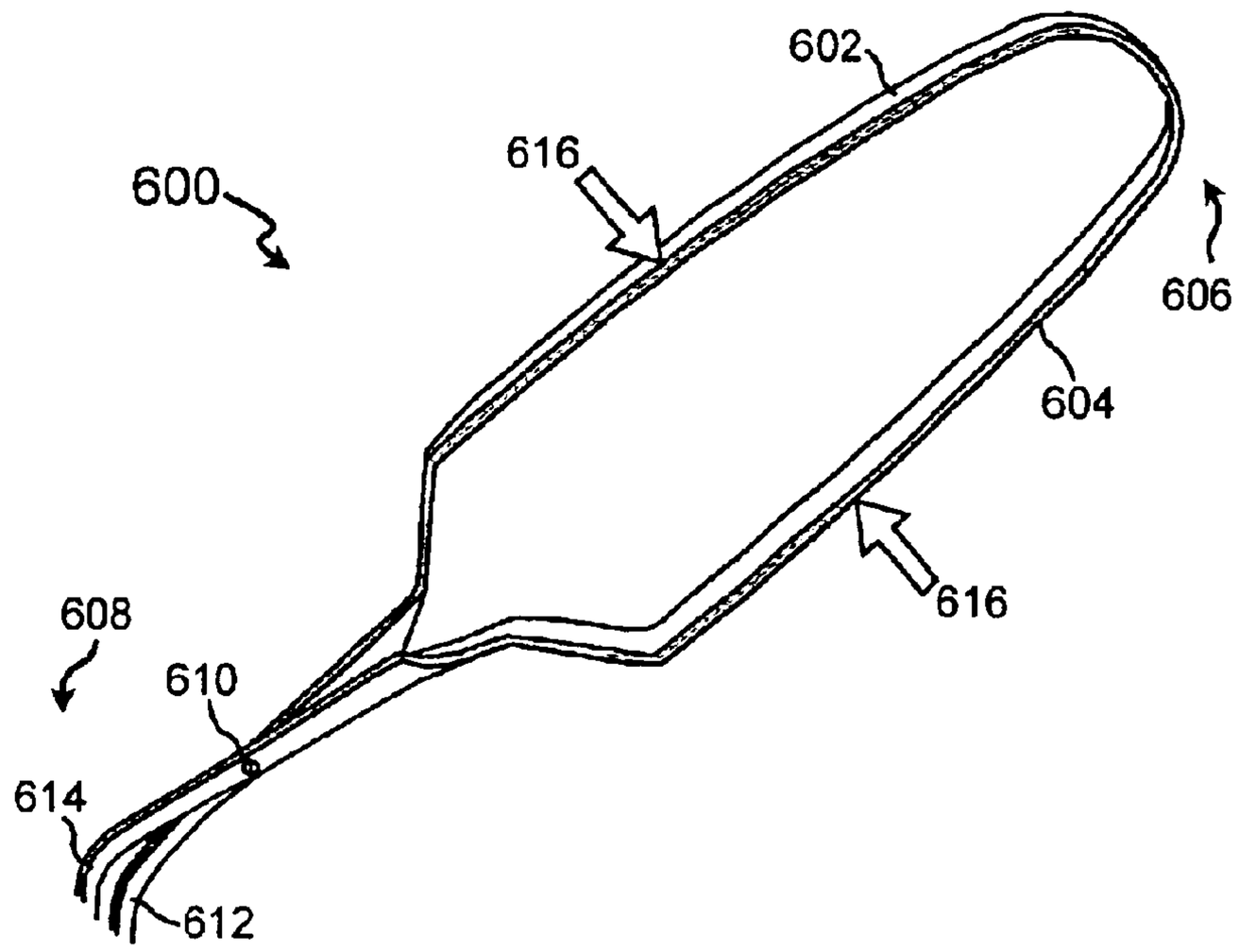
(57) **ABSTRACT**

A versatile system for the manipulation of dental appliances is described that includes a grasping assembly coupled to an actuating assembly. Members of the grasping assembly are shaped to approximate contour of the dental appliance. An apical seating member is disposed upon the grasping assembly to facilitate the application of seating pressure. The grasping assembly may be removably or permanently coupled to the actuating assembly. Portions of the actuating assembly, the grasping assembly, or both the actuating and grasping assemblies may be shaped to facilitate distal, mesial, or both distal and mesial manipulation of the dental appliance.

15 Claims, 6 Drawing Sheets



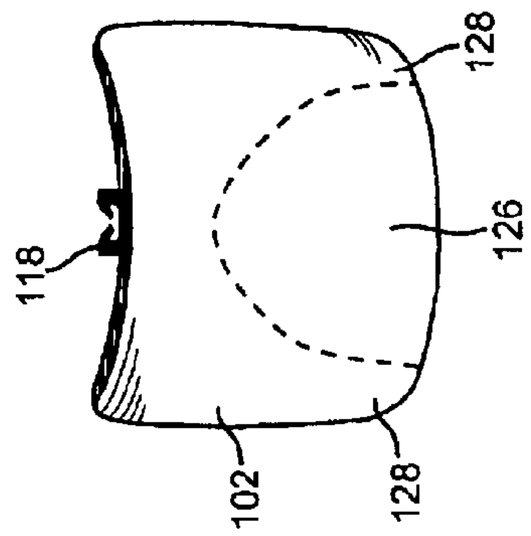


FIG. 1c

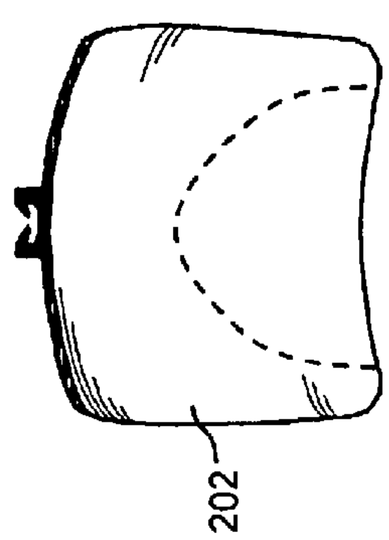


FIG. 2c

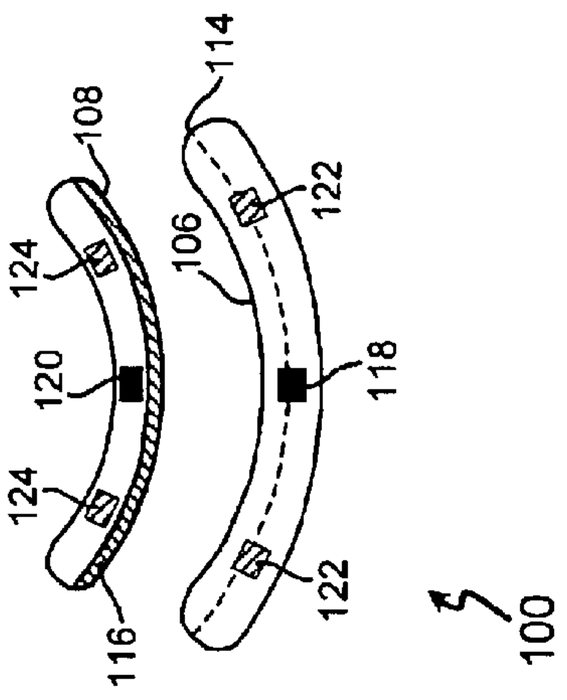


FIG. 1b

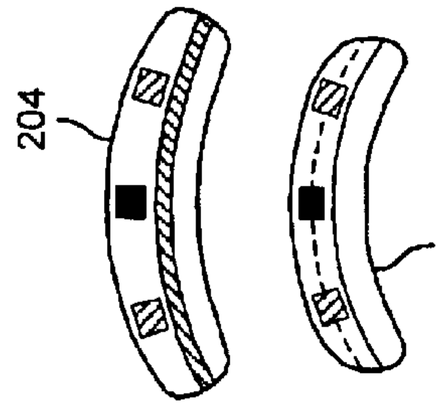


FIG. 2b

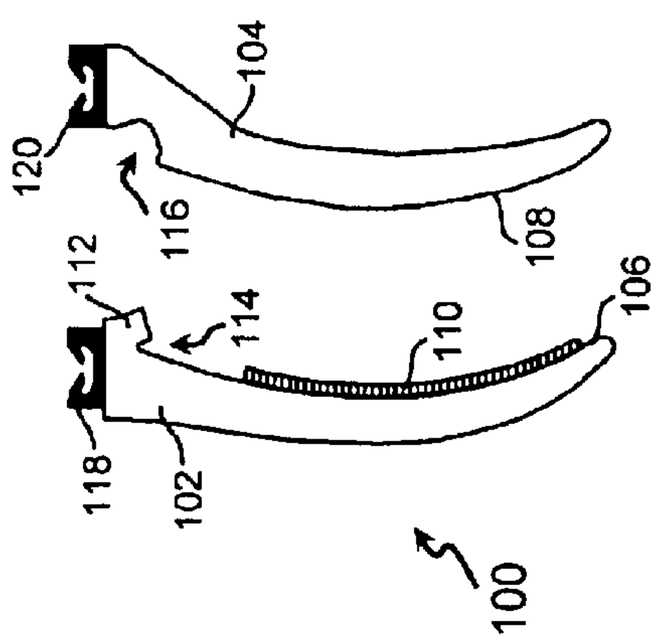


FIG. 1a

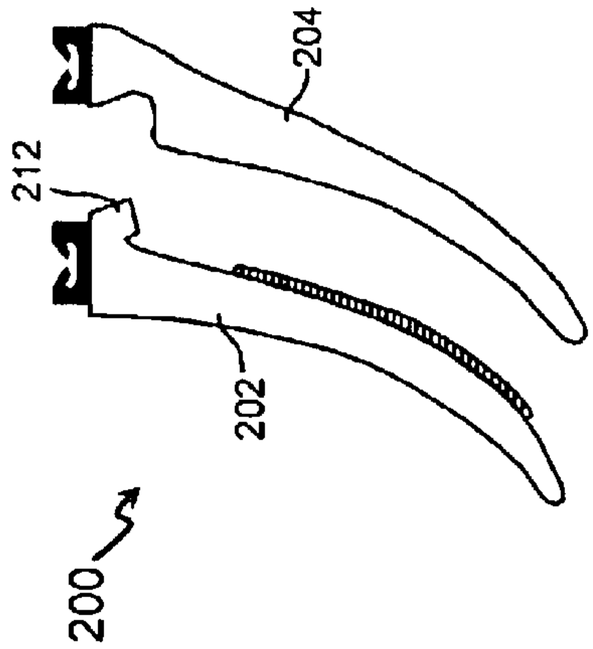


FIG. 2a

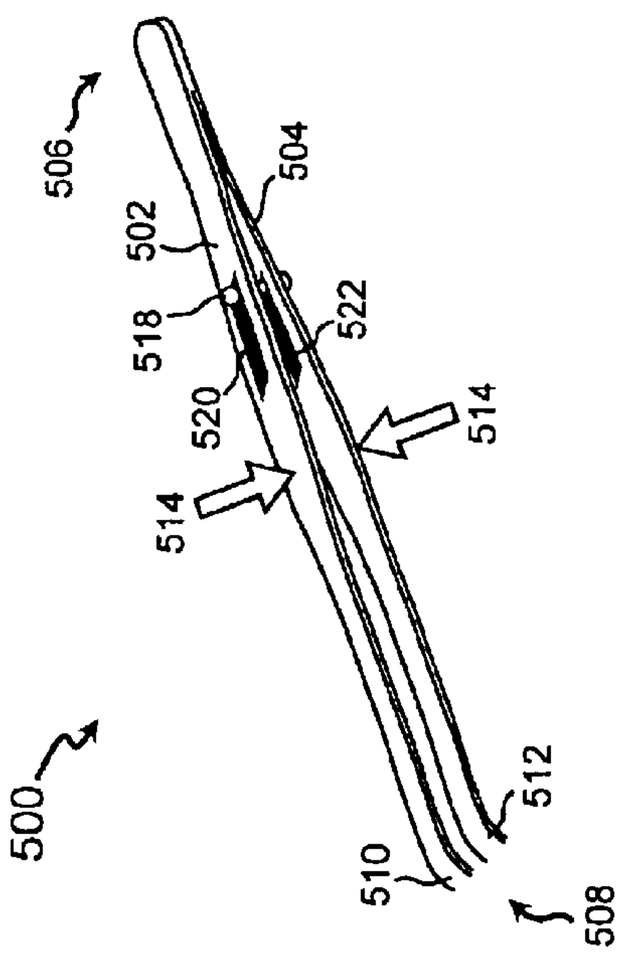


FIG. 5

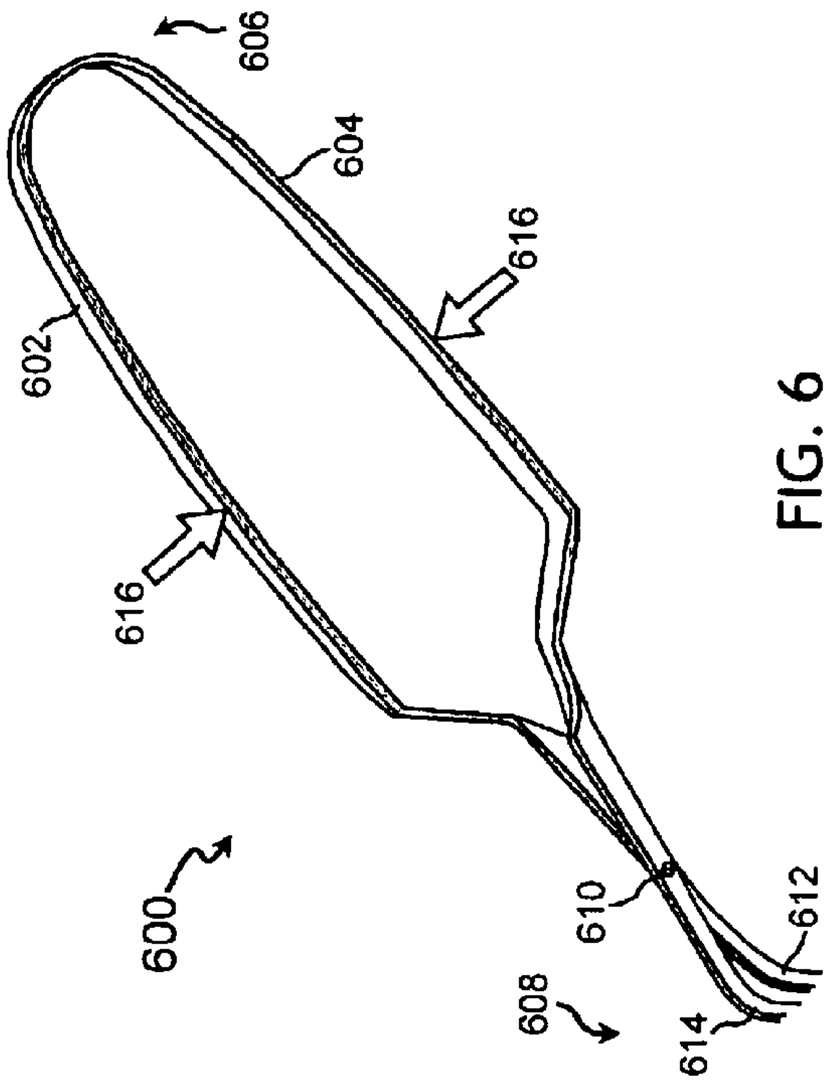


FIG. 6

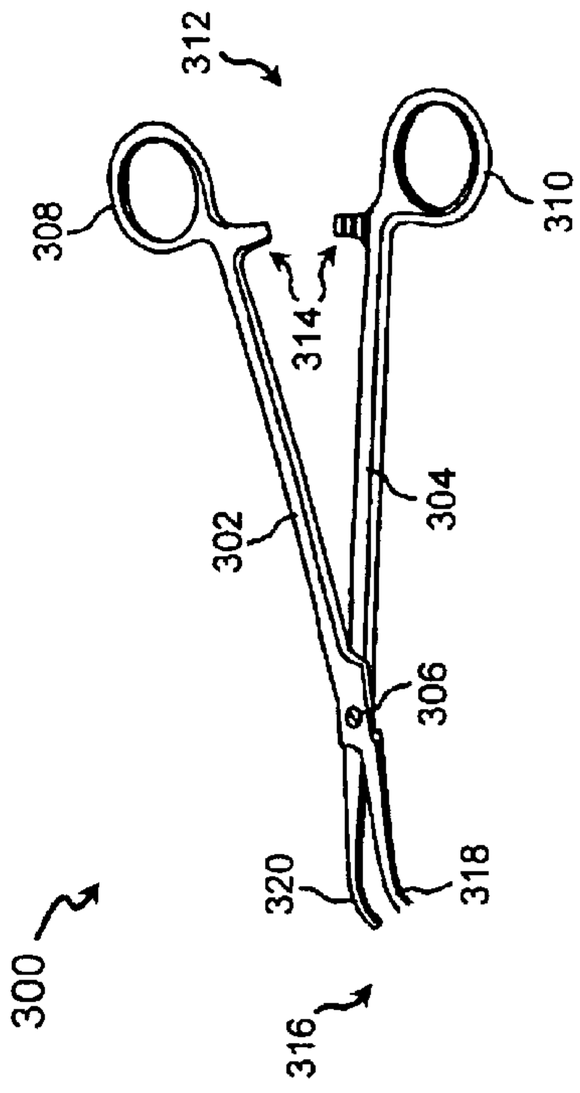


FIG. 3

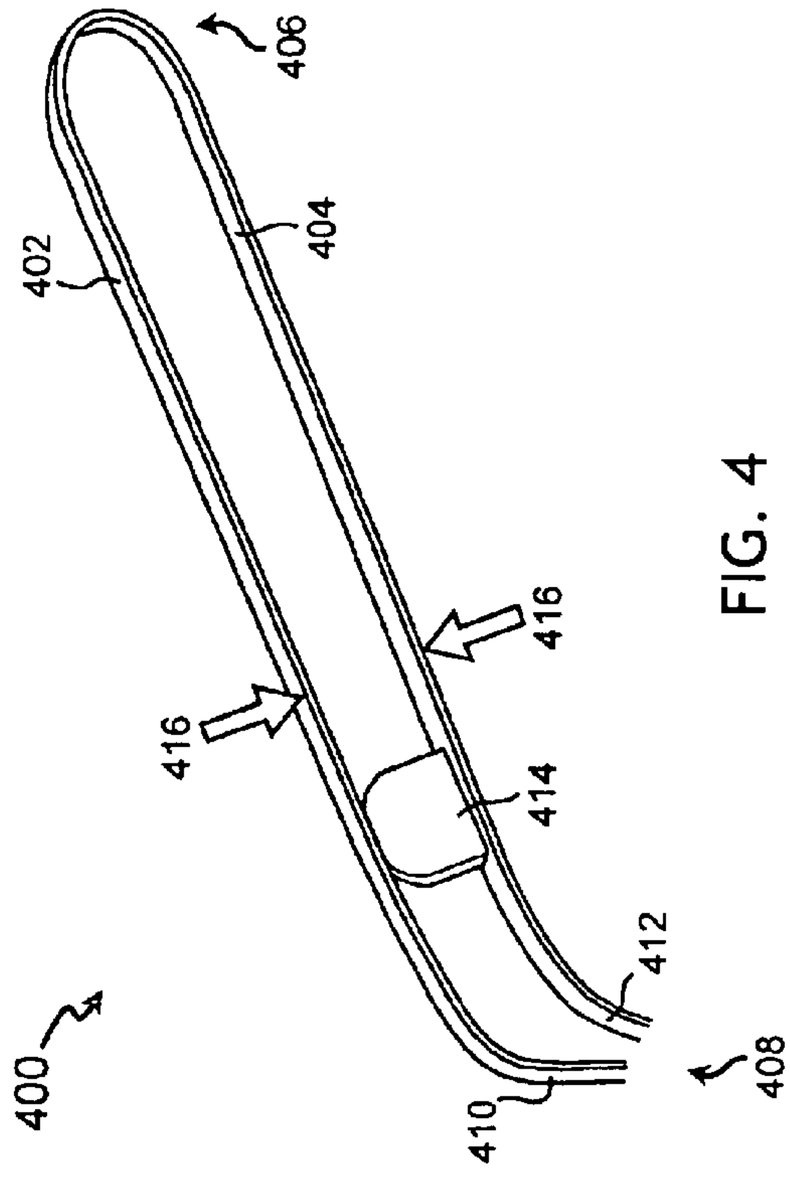


FIG. 4

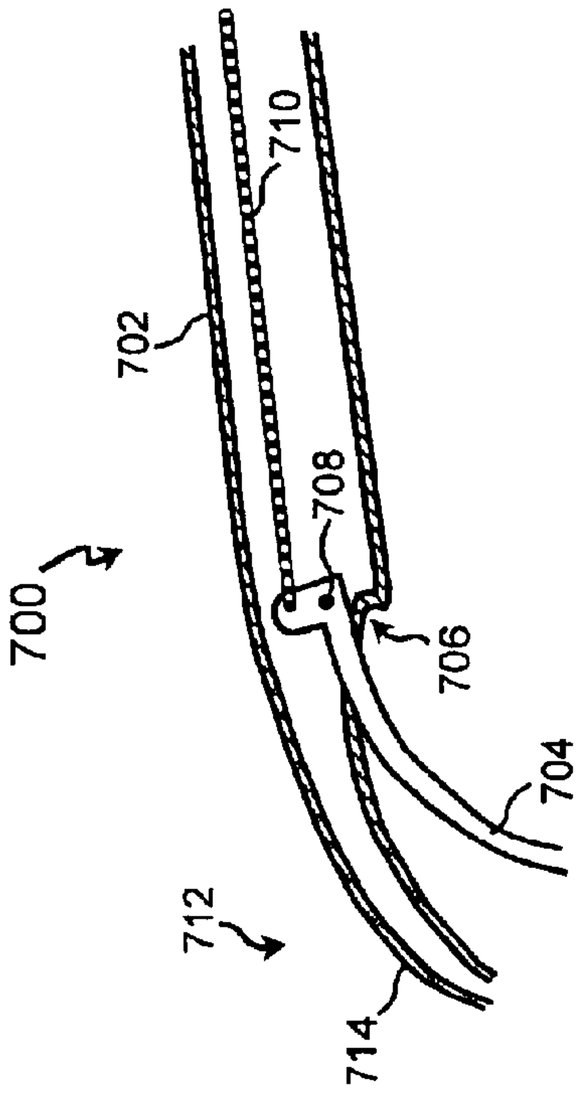


FIG. 7

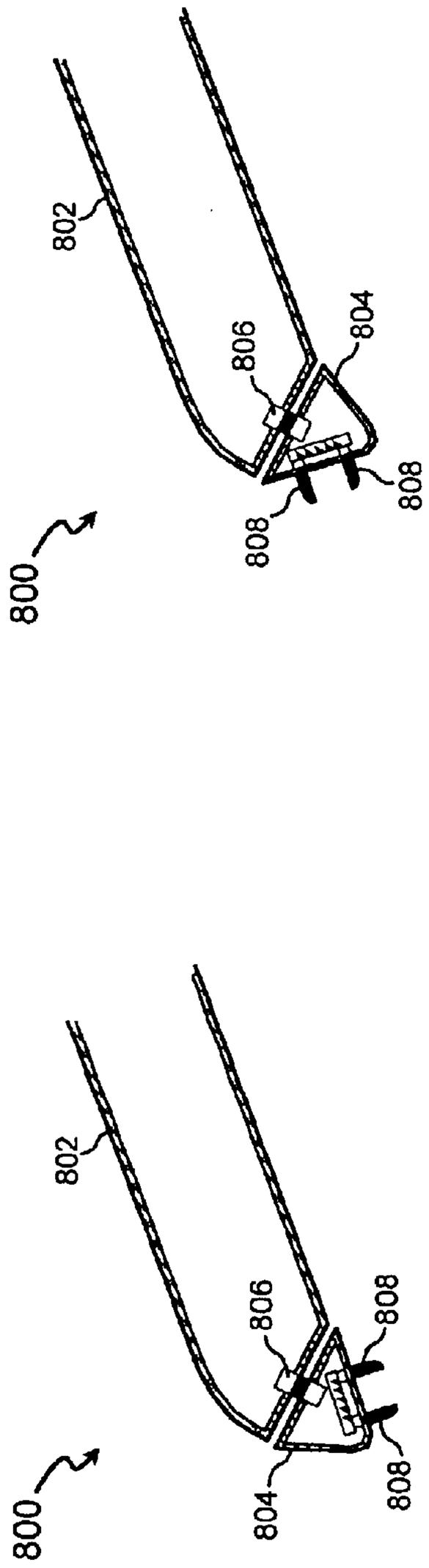


FIG. 8b

FIG. 8a

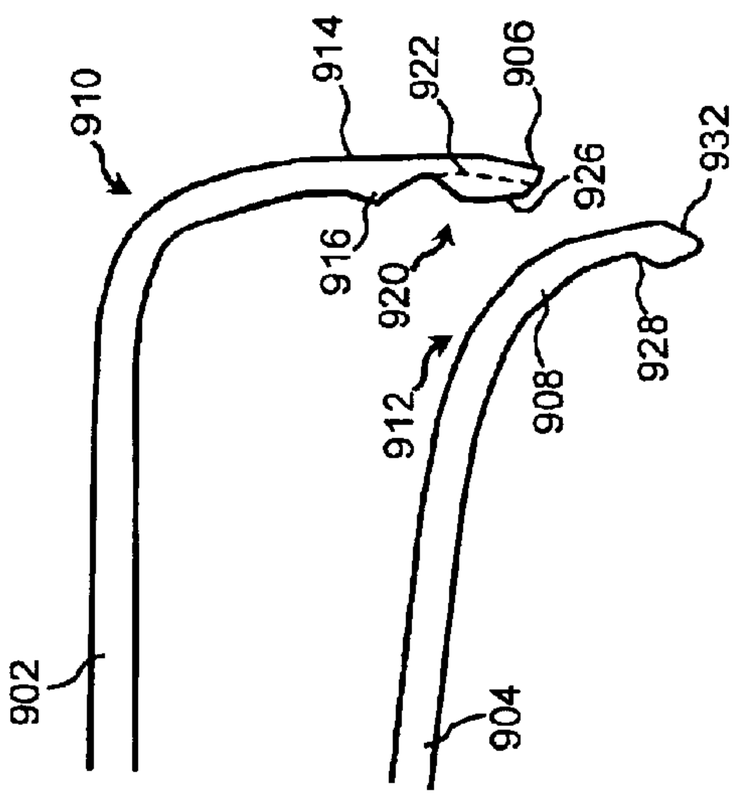


FIG. 9a

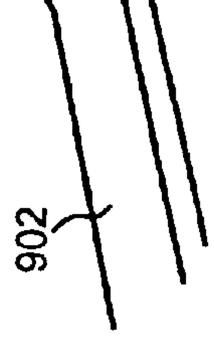


FIG. 9c

FIG. 9b

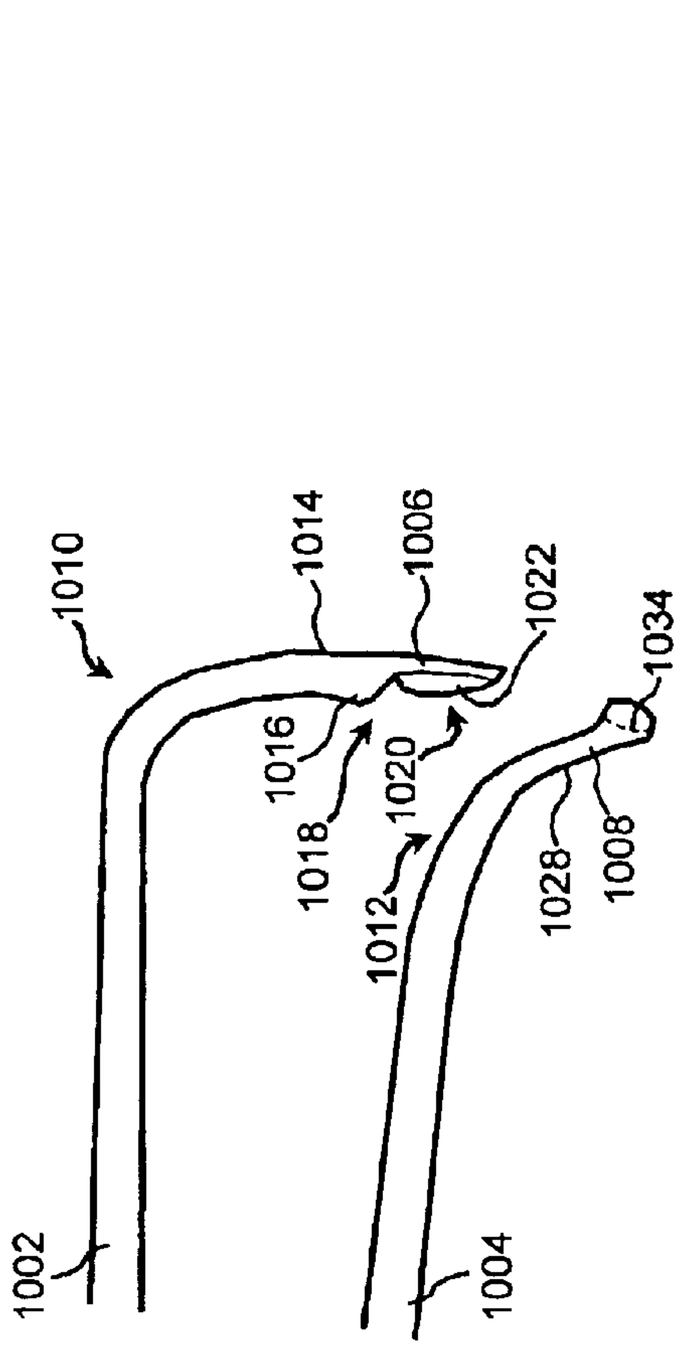


FIG. 10a

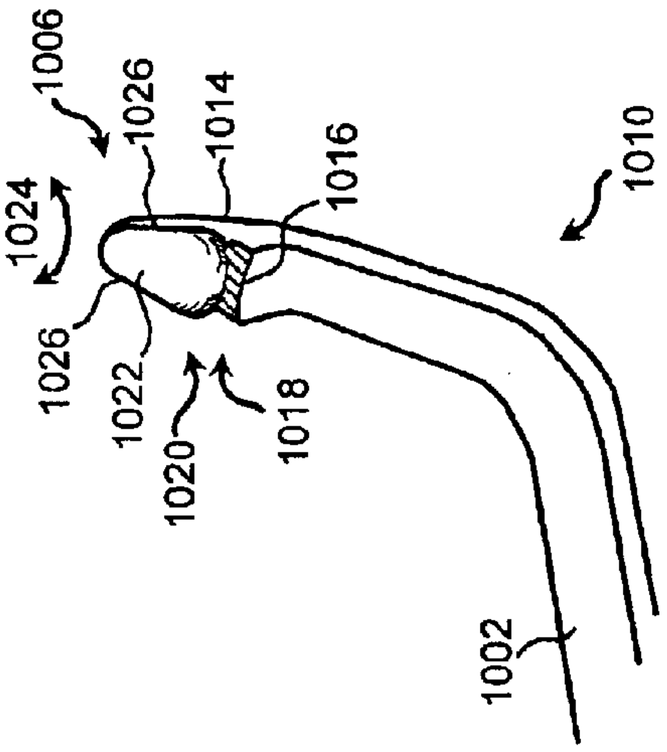


FIG. 10c

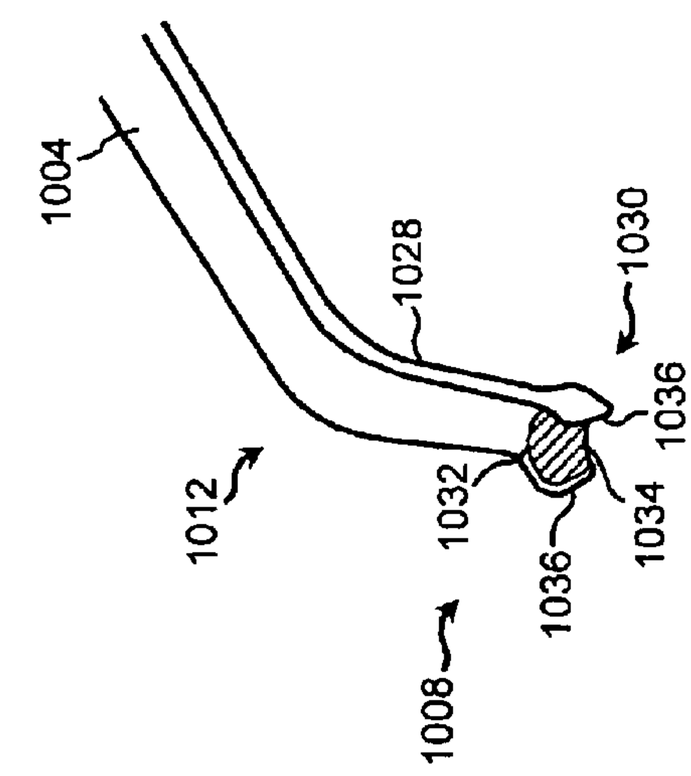


FIG. 10b

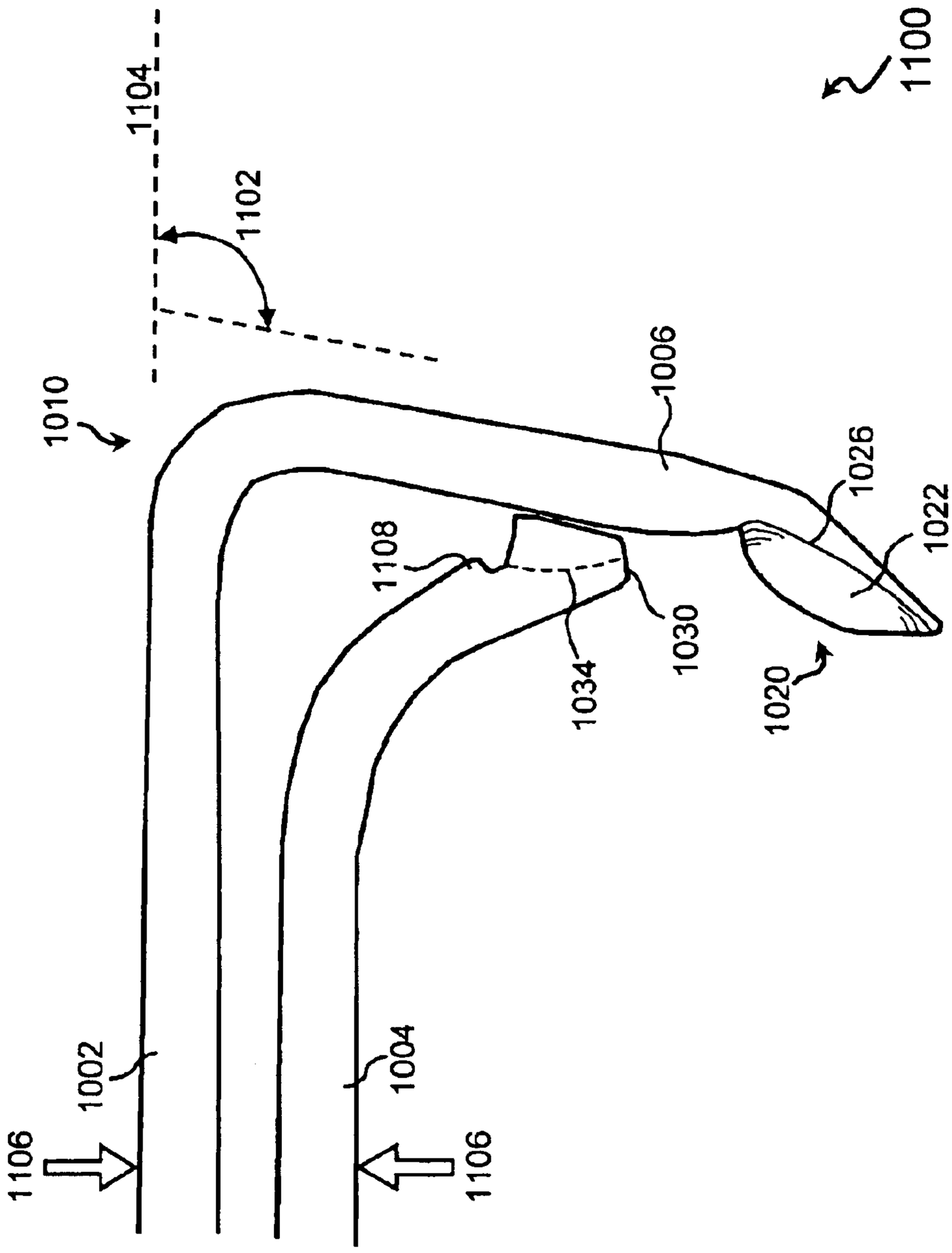

1100
1104
1102
1010
1006
1026
1022
1108
1030
1034
1020
1002
1004
1106
1106

FIG. 11

VERSATILE SYSTEM FOR MANIPULATION OF DENTAL APPLIANCES

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation-in-part of U.S. application Ser. No. 10/156,596, filed on May 28, 2002 now U.S. Pat. No. 6,699,039.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to dentistry tools and, more specifically, to a versatile and ergonomic system for manipulation of dental appliances.

BACKGROUND OF THE INVENTION

Dentistry, particularly restorative dentistry, is a demanding craft—requiring a skillful blend of structural engineering and aesthetics. Dentists must artfully construct and shape what are often very complicated restorative structures while working within the confined space of a patient's mouth. Further complicating this already challenging task are safety and sanitary requirements, ergonomic problems, and concerns about patient comfort. At its best, such work might be considered tedious. At its worst, such work might be considered nearly impossible.

As a result, a number of devices and methodologies have been developed to aid dentists in performing routine procedures. Specialized handpieces, powered tools, shielding and grasping devices are continually developed to assist in nearly every aspect of routine dentistry. Often times, however, the development of one aid may simplify a particular aspect of a procedure while complicating other aspects of the same procedure. Furthermore, there are a number of routine procedures, for which no specialized tools exist, that require dentists to utilize existing devices in an unintended fashion. Thus, restorative dentistry often relies on both specialization and improvisation.

Consider, for example, the tools and procedures involved in filling interproximal cavities. Depending upon the location and size of the filling needed, a dentist may have a very difficult time forming a filling of proper structural integrity that provides a desired aesthetic appearance and proper interproximal contact. A relatively popular method of interproximal filling relies on the use of sectional matrix bands.

Sectional matrix bands are small appliances that serve, essentially, as a form for interproximal fillings (especially bonded fillings) when some portion of the external tooth structure is missing or has been removed. The bands are used to restore the tooth structure to its natural contour, without having to dispose excessive bonding material in the area surrounding the filling. These matrix bands are generally formed of aluminum or some other similar semi-rigid material, and typically come in a number of sizes to match tooth and filling sizes. The bands usually have some degree of concavity, in addition to multiple degrees of curvature, to match the often asymmetrical, quasi-spherical contour of a tooth. After proper placement and seating, the matrix bands are usually held in place by some sort of matrix retainer (e.g., a wedge or bi-tine ring).

Thus, once a sectional matrix band is in place, the filling procedure is significantly simplified. The proper placement and seating of a sectional matrix band is, however, no trivial task. It is, in fact, a task that appears to be widely recognized as difficult and involved—and one for which conventional apparatus and methods are not properly adapted.

Conventionally, sectional matrix bands have been placed using only the dentist's fingers, or placed by simple tweezers, straight pliers, or even cotton pliers. These conventional methods share a number of common problems and challenges, and each individual method presents its own unique problems and concerns.

One primary concern is maintaining the integrity of the matrix band itself. Until properly placed, the band is highly susceptible to bending and crimping. This can lead to unacceptable deformities in the band, requiring removal and placement of a new band, or acceptance of a structurally or aesthetically inferior filling.

Even the most nimble of dentists, with the daintiest of fingers, may have difficulty working within the limited space of a patient's mouth to properly place a sectional matrix band without deforming the band. The location of the required filling can further complicate the procedure. The further posterior the required filling is (e.g., between molars), or if the filling is on the mesial surface of a tooth, the more difficult it is to manually place the small, flexible sectional matrix bands. Furthermore, placement by finger may be much more difficult for dentists with larger hands.

Conventional placement methods typically require a great deal of manipulation at ergonomically awkward angles for a dentist. That ergonomically improper manipulation might, over time, lead to degenerative neuromuscular problems. Furthermore, if there is strong interproximal contact between the teeth, the dentist must either ply the teeth apart, such that the instrument used to ply the teeth apart does not impede the placement of the band, or break interproximal contact, in order to place the band without deforming it. Breaking interproximal contact may require removal of an excessive (i.e., unacceptable) amount of tooth structure, however, especially where only a small filling is required.

Although some conventional methods of sectional matrix band placement utilize conventional, general-purpose instruments (e.g., conventional tweezers and pliers)—thereby reducing some of the problems associated with working in the confined space of a patient's mouth—extensive instrument manipulations, ergonomic challenges, and increased potential for damage to the band remain problematic. Using such conventional instruments may still be difficult for posterior placements.

Furthermore, such general-purpose instruments are typically unsuitable for firmly grasping and manipulating the curved sectional matrix bands without deformation. Most such instruments have flat, planar grasping surfaces that can bend or damage a matrix band. The grasping surfaces themselves are generally not arcuate in nature, and thus will not tightly grasp a significant cross section of a sectional matrix band without deformation. Finally, most such conventional instruments are not curved or angled to provide reliable sectional matrix band disposition in both distal and mesial orientations.

More recently, some efforts have been made to redesign or adapt conventional instruments especially for use in sectional matrix band placement. Typically, such adaptations comprise a single, planar angulation or curvature of the grasping end of a simple tweezer or plier-type assembly. Although such adaptations might reduce some of the difficulty in the placement of sectional matrix bands, the full benefit of specialized instruments remains unrealized. For example, conventional instruments typically remain unbiased toward either mesial or distal orientations. Moreover, such instruments typically remain unsuitable for firmly grasping and manipulating the curved sectional matrix bands

without deformation. Most such instruments have flat grasping surfaces that are not capable of tightly grasping a significant cross section of a sectional matrix band without deformation.

Thus, sectional matrix band placement is often tedious, time-consuming and, in some cases, not possible using conventional instruments.

SUMMARY OF THE INVENTION

A system that provides easy and reliable placement and removal of specially contoured dental appliances, such as sectional matrix bands, while maintaining the structural and aesthetic integrity of the appliance, readily usable for both distal and mesial manipulations in an ergonomically proper manner, is now needed. This system should provide dentists with a tool that simplifies restorative procedures without deforming or damaging the appliances being placed. The system should thus provide relief from problems associated with conventional methods and apparatus.

Comprehending this, the present invention provides a versatile system for the efficient manipulation of specially contoured dental appliances, especially sectional matrix bands. The present invention provides a contoured grasping member assembly for grasping the dental appliance. The grasping members may be contoured in a variety of topologies and orientations, such that their contour closely approximates the contour of an appliance to be manipulated. Such contouring may be formed in vertical, lateral, or a combination of vertical and lateral, planes using combinations of straight, curved, or angled surfaces. Angulation, curvature, or other deformation may further be employed to facilitate manipulations in distal, mesial, or both mesial and distal orientations.

The present invention also provides an actuating assembly, to which the grasping member assembly may be permanently or temporarily attached, for actuating the grasping member assembly. In the actuating assembly, or in its coupling to the grasping member assembly, angulation, curvature or other deformation may also be employed to facilitate manipulations in distal, mesial, or both mesial and distal orientations. The actuating assembly may be configured such that actuation increases pressure between the grasping members, or configured such that actuation decreases pressure between the grasping members, depending upon the desired orientation and performance characteristics.

The grasping member, or members, on one side of the assembly may include an apical seating feature disposed along an upper edge, to secure the appliance in place and assist in applying seating pressure to the appliance.

Other features and advantages of the present invention will be apparent to those of ordinary skill in the art upon reference to the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, including its features and advantages, reference is made to the following detailed description, taken in conjunction with the following drawing figures. Corresponding numerals and symbols in the different figures refer to corresponding parts unless otherwise indicated:

FIGS. **1***a*–**1***c* illustrate an embodiment of a grasping member assembly according to the present invention;

FIGS. **2***a*–**2***c* illustrate another embodiment of a grasping member assembly according to the present invention;

FIG. **3** illustrates an embodiment of an actuating assembly according to the present invention;

FIG. **4** illustrates another embodiment of an actuating assembly according to the present invention;

FIG. **5** illustrates another embodiment of an actuating assembly according to the present invention;

FIG. **6** illustrates another embodiment of an actuating assembly according to the present invention;

FIG. **7** illustrates another embodiment of an actuating assembly according to the present invention;

FIGS. **8***a* and **8***b* illustrate another embodiment of an actuating assembly according to the present invention;

FIGS. **9***a*–**9***c* illustrate another embodiment of an instrument according to the present invention;

FIGS. **10***a*–**10***c* illustrate another embodiment of an instrument according to the present invention; and

FIG. **11** illustrates another embodiment of an instrument according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

While the making and using of various embodiments of the present invention are discussed in detail below, it should be apparent to those of skill in the art, upon reference to this disclosure, that the system and teachings of the present invention are applicable in a applications. For purposes of explanation and illustration, however, the present invention is hereafter described in reference to the handling and placement of sectional matrix bands for use in an interproximal filling. The principles and teachings disclosed herein, however, are applicable to a wide range of dental instruments and appliances. The specific embodiments discussed herein are thus merely illustrative of specific ways to make and use the invention, and do not limit the scope of the invention.

The present invention defines a system, comprising various structures and methods, for placing and removing matrix bands without excessive manipulation and without deforming or damaging the bands. The present invention provides a contoured grasping member assembly for grasping the dental appliance. The grasping members may be contoured in a variety of topologies and orientations, such that their contour closely approximates the contour of an appliance to be manipulated. Such contouring may be formed in vertical, lateral, or a combination of vertical and lateral, planes using combinations of straight, curved, or angled surfaces. Angulation, curvature, or other deformation may further be employed to facilitate manipulations in distal, mesial, or both mesial and distal orientations. Certain grasping members include an apical seat disposed along an upper edge, and the grasping member assembly may be permanently or temporarily attached to a number of actuating assemblies.

The present invention is now described in greater detail with reference now to FIGS. **1***a*–**1***c*. FIG. **1***a* provides a side-view, cross-sectional representation of one embodiment of a grasping member assembly **100** according to the present invention. Assembly **100** comprises first member **102** and second member **104**. A sectional matrix band is grasped between surface **106** of member **102** and surface **108** of member **104**.

Members **102** and **104** may be formed with a matching convex longitudinal curvature. This curvature can be optimized to match the curvature of one particular size and style of matrix band, or can be generalized to closely approximate the curvatures of a number sizes and styles of matrix bands.

Alternatively, members **102** and **104** may be angled, one or more times, to approximate the desired curvature(s) or, in the alternative, may be formed as substantially straight—without any appreciable curvature or angulation.

Surface **106** may, optionally, incorporate a traction feature **110** (e.g., scoring, small serrations, rubber padding) disposed upon, or embedded within, surface **106**. Alternatively, surface **108** may incorporate feature **110**. If feature **110** is utilized, it should be formed or disposed so as not to deform the matrix band during contact therewith, and should be made of a material suitable for assembly **100** (suitable materials discussed hereinafter).

Member **102** further comprises an apical seating feature or member **112**, usually disposed along the upper perimeter of surface **106**. Alternatively, member **112** may be disposed further down along surface **106**, or adjustably disposed along surface **106**, in order to, for example, facilitate grasping matrix bands of various sizes. Generally, however, feature **112** will be disposed somewhere near the top of member **102**. An upper edge of a matrix band is seated against feature **112**, to provide stabilization during placement (or removal) and to provide a bearing point for the application of force when placing the band.

As depicted in FIG. **1**, member **112** comprises a contiguous appendage along member **102**, forming an elongated recess **114** between member **112** and surface **106**. Thus, the upper edge of the matrix band would seat within recess **114** while held by assembly **100**.

Alternatively, feature **112** may comprise an intermittent series of short appendages forming similar recesses. In other alternatives feature **112** may comprise one or more simple flat shelves, or one or more post or semi-spherical protuberances, disposed or formed in a flush relation with surface **106** (i.e., without recess **114**) to provide the required stabilization and bearing point(s). In further alternative embodiments, feature **112** may be formed in similar fashion along member **104**.

In the embodiment depicted in FIGS. **1***a*–**1***c*, however, member **112** is disposed along the outermost member of assembly **100** because of the curvature of members **102** and **104**. Thus, the member farthest from the tooth being filled applies bearing pressure. Member **104** may be formed with a deviation **116** to receive or accommodate member **112** while members **102** and **104** are brought together. Surface **108** is formed of a longitudinal size comparable to, but somewhat smaller than, surface **106** to allow for clearance of seating member **112** when members **102** and **104** are closed tightly together.

Members **102** and **104** further comprise attachment features (or members) **118** and **120**, respectively, disposed along the upper portions thereof. Depending upon the desired actuating assembly to which members **102** and **104** will be coupled, and upon whether such coupling is intended to be permanent or temporary (i.e., removable), features **118** and **120** may be implemented in a number of ways.

For example, if attachment is intended to be removable, members **118** and **120** may comprise a snap-lock or screw-on mechanism. If attachment is intended to be permanent, members **118** and **120** may comprise welds, or some or similar adjoinment, to an actuating member. Alternatively, members **102** and **104** may be formed as a contiguous, integral part of an actuating assembly, such that members **118** and **120** comprise only a transition area indistinguishable from surrounding structure.

Referring now to FIG. **1***b*, a top view representation of assembly **100** is depicted. Members **102** and **104** may be additionally formed with a matching convex lateral curvature. This curvature can be optimized to match the curvature of one particular size and style of sectional matrix band, or can be generalized to closely approximate the curvatures of a number sizes and styles of matrix bands. Alternatively, once again, the same effect may be achieved using one or more angulations. In the alternative, curvature or angulation may be omitted altogether—leaving, in the lateral direction, a substantially planar surface.

Although depicted in FIG. **1***b* as laterally larger, member **102** may be laterally larger, similar, or smaller than member **104**, depending upon the desired support and manipulation characteristics of assembly **100**.

Furthermore, depending upon the desired actuating assembly and the relative sizes, members **102** and **104** may comprise multiple lateral attachment members **122** and **124**, respectively, in addition to or instead of members **118** and **120**. Members **122** and **124** are disposed or formed so as to provide greater lateral stability across the breadth of members **102** and **104**, if those members comprise a single piece. If members **102** and **104** themselves comprise multiple sub-members, then members **122** and **124** may provide individual attachment for each of the sub-members.

As illustrated in FIG. **1***c*, in a front-view representation, member **102** may comprise a single, contiguous structure. Alternatively, one or more partial aperture(s) **126** may be formed in member **102** so as to render multiple tines **128** in the lower portion of member **102**. Another alternative embodiment would render member **102** as set of multiple, physically separated, polygonal or tine sub-members formed or disposed in accordance with the teachings above. All such embodiments provide a broader base of contact with the sectional matrix band than conventional instruments (e.g., cotton pliers)—enabling a dentist to apply rotational force along the horizontal axes of the band. Although not depicted, all of these variations may also be implemented with member **104**. Furthermore, members **102** and **104** can be formed to have matching implementations, or differing combinations of the above-referenced embodiments.

Another embodiment of the present invention is now described with reference to FIGS. **2***a*–**2***c*. FIG. **2***a* provides a side-view, cross-sectional representation of a grasping member assembly **200** according to the present invention. Assembly **200** and its constituent members are essentially identical to assembly **100** and its members, with the exception of curvatures (or angulations) and related orientation considerations. Members **202** and **204**, which correspond to members **102** and **104**, respectively, are formed with a matching concave longitudinal curvature. Again, this curvature can be: optimized to match the curvature of one particular size and style of sectional matrix band; generalized to closely approximate the curvatures of a number of sizes and styles of matrix bands; or omitted altogether. Apical seating feature **212** is disposed along member **202**, which is the innermost member of assembly **200**. Thus, in this embodiment, the member closest to the tooth being filled applies bearing pressure. In alternative embodiments, apical seating feature **212** may be disposed along member **204**.

Referring now to FIG. **2***b*, a top view representation of assembly **200** is depicted. Members **202** and **204** are additionally formed with a matching concave lateral curvature. Again, this curvature can be: optimized to match the curvature of one particular size and style of sectional matrix band; generalized to closely approximate the curvatures of a number of sizes and styles of matrix bands; or omitted

altogether. Although depicted as laterally smaller, member **202** may be laterally larger, similar, or smaller than member **204**, depending upon the desired support and manipulation characteristics of assembly **200**.

As illustrated in FIG. **2***c*, member **202** may comprise a single contiguous structure, a tined structured, or multiple sub-member structures (not depicted). Again, all of these embodiments are also possible with member **204**, and members **202** and **204** can be formed to have matching implementations, or differing combinations of the above-referenced embodiments.

Although assemblies **100** and **200** have been depicted and described as comprising multiple members, other embodiments thereof may comprise only a single member. For example, it is possible that only member **102** of assembly **100** may be disposed upon some simple actuating member (e.g., a handpiece). While such an embodiment would still provide advantages over conventional methods and apparatus, it would not provide the dentist with the same ability to secure (i.e., by grasping) a sectional matrix band for manipulation and proper placement as the multiple member embodiments do.

With the exception of the single member embodiment above, the grasping member assemblies **100** and **200** of the present invention should be coupled to, or formed as part of, some compound actuating assembly. According to the present invention, a compound actuating assembly may comprise either a bifurcated assembly (e.g., tweezers, forceps, pliers), or a stylus assembly (e.g., specialized handpiece, pneumatic drill piece), adapted to meet the requirements of the present invention. Although an almost limitless range of actuating assembly implementations are possible, the present invention requires that an actuating assembly be of a profile and length that allows adequate access to all teeth for the grasping assembly without requiring excessive manipulation by the dentist. The actuating assembly should provide sufficient pressure between the members of the grasping assembly to securely hold a matrix band. Preferably, the actuating assembly should provide the dentist with the ability to selectively adjust the grasping pressure applied.

Referring now to FIG. **3**, assembly **300** illustrates one embodiment of a bifurcated actuating assembly according to the present invention. Assembly **300** comprises first body member **302** and second body member **304**, counter-rotationally coupled together about hinge **306**. As depicted, assembly **300** comprises a scissor-style forceps assembly, having finger retainers **308** and **310** coupled to members **302** and **304**, respectively, at handling end **312** of the assembly. End **312** is the end of assembly **300** that a dentist will grasp while using and manipulating it. Alternatively, members **302** and **304** may just have flat, unfinished terminations at end **312**, or may have some other devices disposed in place of retainers **308** and **310** to provide grasping assistance (e.g., scored surfaces, rubber pads). Optionally, assembly **300** may further comprise a locking assembly **314** to, at a minimum, secure closure of assembly **300** and, further optionally, to provide a progression of locking pressures. As depicted in FIG. **3**, assembly **314** comprises two counterposed, ratcheting hasps disposed upon members **302** and **304** that lock together progressively tighter as closing pressure is applied to members **302** and **304**, and release from one another when a slight orthogonal force is applied thereto. Alternatively, assembly **314** may comprise a simple latch, a screw-type apparatus, a spring apparatus, or any other contrivance that provides the desired locking and pressure characteristics.

The other end of assembly **300** is actuating end **316**. At end **316**, members **302** and **304** terminate in actuating portions **318** and **320**, respectively. Members of a grasping assembly may couple to, or be formed as part of, the open ends of portions **318** and **320**. Portions **318** and **320** are angled or curved with respect to members **302** and **304** to provide an attached grasping assembly proper access to either distal or mesial surfaces, or both. The angles or curvatures of portions **318** and **320** are matched and aligned to provide proper closure and alignment of grasping assembly members. The curvature or angling of portions **318** and **320** enables a dentist to place a sectional matrix band in the desired location without manipulating the entire actuating assembly to some extreme angle within a patient's mouth. Depending on whether the coupling of grasping assembly members to portions **318** and **320** is permanent or temporary, and on whether assembly **300** is intended to be used for only mesial, only distal, or both mesial and distal orientations, portions **318** and **320** may be formed with a specific or a general curvature or angling. Alternatively, where the grasping assembly members themselves are angled or curved to facilitate a particular orientation, portions **318** and **320** may be formed substantially straight.

By way of illustration, separate tools for mesial and distal orientations might be desired. Thus, two actuating assemblies would be formed. Each may have grasping assemblies permanently attached thereto. The tool intended for use in mesial orientations may comprise actuating portions having a greater degree of curvature or angling than the actuating portions of the tool intended for distal orientations—effecting more efficient and less manipulation-intensive placements of both the mesial and distal oriented appliances.

Alternatively, a single tool for use in either orientation may be desired. Such a tool might have actuating portions of a generalized curvature or angle, and might rely on temporary attachment of, for example, grasping assembly **100** for mesial orientation and grasping assembly **200** for distal orientation. In still another alternative embodiment, a tool may comprise actuating portions of adjustable or deformable curvature or angling, allowing a dentist to select his own orientation based on the procedure to be completed.

Finally, hinge **306** may be disposed along members **302** and **304** in a position generally biased toward end **316**. This renders members **302** and **304** as relatively long lever arms, requiring minimal application of force and minimal separation of members **302** and **304** at end **312** to provide sufficient actuation of portions **318** and **320**.

Referring now to FIG. **4**, another embodiment of a bifurcated actuating assembly **400** is illustrated. Assembly **400** comprises first body member **402** and second body member **404**, conjoined together as a single unit at closed end **406**. The other end of assembly **400** is actuating end **408**. At end **408**, members **402** and **404** terminate in actuating portions **410** and **412**, respectively. Members of a grasping assembly may be coupled to, or formed as part of, the open ends of portions **410** and **412**.

As depicted, assembly **400** comprises a specialized tweezer-style assembly—one that brings actuating portions **410** and **412**, and grasping assembly members coupled thereto, together at rest. Assembly **400** comprises a fulcrum member **414** disposed between members **402** and **404**. Member **414** is disposed is a position biased towards end **408**, and portions **410** and **412** are formed, such that grasping assembly members coupled to portions **410** and **412** are brought together and engaged (i.e., clamped) with maximum force when assembly **400** is not actuated. Assembly **400** is actuated by applying pressure to areas **416** along members **402** and **404**, between fulcrum **414** and end **406**—separating portions **410** and **412** and releasing the grasp of the grasping assembly.

Optionally, members **402** and **404** may have some devices disposed thereon, proximal to end **406**, to provide grasping assistance (e.g., scored surfaces, rubber pads). Furthermore, assembly **400** may optionally comprise a locking assembly (not depicted) to, at a minimum, secure the resting closure of assembly **400**. The locking assembly may comprise a latch, a hasp, a spring apparatus, or any other contrivance that provides the desired locking characteristic.

At end **408**, the grasping assembly members may couple to, or be formed as part of, the open ends of portions **410** and **412**. Portions **410** and **412** are angled or curved with respect to members **402** and **404** to provide an attached grasping assembly proper access to either distal or mesial surfaces, or both. The angles or curvatures of portions **410** and **412** are matched and aligned to provide proper closure and alignment of grasping assembly members. Again, the curvature or angling of portions **410** and **412** enables a dentist to place a matrix band in the desired location without manipulating the entire actuating assembly to some extreme angle within a patient's mouth. Depending on whether the coupling of grasping assembly members to portions **410** and **412** is permanent or temporary, and on whether assembly **400** is intended to be used for only mesial, only distal, or both mesial and distal orientations, portions **410** and **412** may be formed with a specific or a general curvature or angling or may, in the alternative, be substantially straight.

In one embodiment, for example, separate tools for mesial and distal orientations might be desired. Thus, two actuating assemblies are formed. Each may have grasping assemblies permanently attached thereto. The tool intended for use in mesial orientations would comprise actuating portions having a greater degree of curvature or angling than the actuating portions of the tool intended for distal orientations—effecting more efficient and less manipulation-intensive placements of both the mesial and distal oriented appliances.

Alternatively, a single tool for use in either orientation may be desired. Such a tool might have actuating portions of a generalized curvature or angle, and might rely on temporary attachment of, for example, grasping assembly **100** for mesial orientation and grasping assembly **200** for distal orientation. In still another alternative embodiment, a tool may comprise actuating portions of adjustable or deformable curvature or angling, allowing a dentist to select his own orientation based on the procedure to be completed.

Referring now to FIG. **5**, another embodiment of a bifurcated actuating assembly **500** is illustrated. Assembly **500** comprises first body member **502** and second body member **504**, joined together as a single unit at closed end **506**. The other end of assembly **500** is actuating end **508**. At end **508**, members **502** and **504** terminate in actuating portions **510** and **512**, respectively. Members of a grasping assembly may be coupled to, or formed as part of, the open ends of portions **510** and **512**.

As depicted, end **506** of assembly **500** comprises a conventional tweezer-style assembly—one that requires the application of closing pressure **514** somewhere along members **502** and **504** in order to bring actuating portions **510** and **512**, and grasping assembly members coupled thereto, together. Thus, grasping assembly members coupled to portions **510** and **512** are brought together and engaged (i.e., clamped) with increasing force as the pressure **514** applied to assembly **500** is increased. Removing pressure **514** from assembly **500** separates portions **510** and **512** and releases the grasp of the grasping assembly. Optionally, members **502** and **504** may have some devices disposed thereon, proximal to end **506**, to provide grasping assistance (e.g., scored surfaces, rubber pads).

Furthermore, assembly **500** may optionally comprise a locking assembly **516** to, at a minimum, secure closure of assembly **500** and, further optionally, to provide a progressive locking pressure. As depicted in FIG. **5**, assembly **516** comprises a sliding bar member **518** disposed within apertures **520** and **522**, themselves disposed within members **502** and **504**, respectively. Sliding member **518** may be positioned and anchored within apertures **520** and **522** such that as it moved in the direction of end **508**, members **502** and **504** are forced closer together—providing or matching pressure **514**. Thus, a dentist may lock assembly **500** at a desired grasping pressure after applying closing pressure directly to members **502** and **504**, or assembly **516** may be used to indirectly close assembly **500** to a desired grasping pressure before locking it in place. Pressure between grasping assembly members may be increased by moving member **518** further in the direction of end **508**. Alternatively, assembly **516** may comprise a thumbwheel-type assembly that enables a dentist to indirectly close, lock, and increase the grasping pressure for, assembly **500** by turning the thumbwheel. In other embodiments, assembly **516** may comprise a simple latch, a screw-type apparatus, a spring apparatus, or any other contrivance that provides the desired locking and pressure characteristics.

At end **508**, the grasping assembly members may be coupled to, or formed as part of, the open ends of portions **510** and **512**. Portions **510** and **512** are angled or curved with respect to members **502** and **504** to provide an attached grasping assembly proper access to either distal or mesial surfaces, or both. The angles or curvatures of portions **510** and **512** are matched and aligned to provide proper closure and alignment of grasping assembly members. Again, the curvature or angling of portions **510** and **512** enables a dentist to place a sectional matrix band in the desired location without manipulating the entire actuating assembly to some extreme angle within a patient's mouth. Depending on whether the coupling of grasping assembly members to portions **510** and **512** is permanent or temporary, and on whether assembly **500** is intended to be used for only mesial, only distal, or both mesial and distal orientations, portions **510** and **512** may be formed with a specific or a general curvature or angling or may, in the alternative, be substantially straight.

In one embodiment, for example, separate tools for mesial and distal orientations might be desired. Thus, two actuating assemblies are formed. Each may have grasping assemblies permanently attached thereto. The tool intended for use in mesial orientations would comprise actuating portions having a greater degree of curvature or angling than the actuating portions of the tool intended for distal orientations—effecting more efficient and less manipulation-intensive placements of both the mesial and distal oriented appliances.

Alternatively, a single tool for use in either orientation may be desired. Such a tool might have actuating portions of a generalized curvature or angle, and rely on temporary attachment of, for example, grasping assembly **100** for mesial orientation and grasping assembly **200** for distal orientation. In still another alternative embodiment, a tool may comprise actuating portions of adjustable or deformable curvature or angling, allowing a dentist to select his own orientation based on the procedure to be completed.

Referring now to FIG. **6**, assembly **600** illustrates another embodiment of a bifurcated actuating assembly according to the present invention. Assembly **600** comprises first body member **602** and second body member **604**, conjoined together as a single unit at closed end **606**. The other end of assembly **600** is actuating end **608**. Assembly **600** further

comprises hinge **610**, disposed along members **602** and **604** proximal to end **608**, and about which members **602** and **604** are counter-rotationally coupled together. At end **608**, members **602** and **604** terminate in actuating portions **612** and **614**, respectively. Members of a grasping assembly may be coupled to, or formed as part of, the open ends of portions **612** and **614**.

As depicted, assembly **600** comprises a specialized scissor-style assembly—one that brings actuating portions **612** and **614**, and grasping assembly members coupled thereto, together at rest. Assembly **600** is configured, and portions **612** and **614** are formed, such that grasping assembly members coupled to portions **612** and **614** are brought together and engaged (i.e., clamped) with maximum force when assembly **600** is not actuated. Assembly **600** is actuated by applying pressure to areas **616** along members **602** and **604**, between hinge **610** and end **606**—separating portions **612** and **614** and releasing the grasp of the grasping assembly.

Optionally, members **602** and **604** may have some devices disposed thereon, proximal to end **606**, to provide grasping assistance (e.g., scored surfaces, rubber pads). Furthermore, assembly **600** may optionally comprise a locking assembly (not depicted) to, at a minimum, secure the resting closure of assembly **600**. The locking assembly may comprise a latch, a hasp, a spring apparatus, or any other contrivance that provides the desired locking characteristic.

At end **608**, the grasping assembly members may couple to, or be formed as part of, the open ends of portions **612** and **614**. Portions **612** and **614** are angled or curved with respect to members **602** and **604** to provide an attached grasping assembly proper access to either distal or mesial surfaces, or both. The angles or curvatures of portions **612** and **614** are matched and aligned to provide proper closure and alignment of grasping assembly members. Again, the curvature or angling of portions **612** and **614** enables a dentist to place a sectional matrix band in the desired location without manipulating the entire actuating assembly to some extreme angle within a patient's mouth. Depending on whether the coupling of grasping assembly members to portions **612** and **614** is permanent or temporary, and on whether assembly **600** is intended to be used for only mesial, only distal, or both mesial and distal orientations, portions **612** and **614** may be formed with a specific or a general curvature or angling or may, in the alternative, be substantially straight.

In one embodiment, for example, separate tools for mesial and distal orientations might be desired. Thus, two actuating assemblies are formed. Each may have grasping assemblies permanently attached thereto. The tool intended for use in mesial orientations would comprise actuating portions having a greater degree of curvature or angling than the actuating portions of the tool intended for distal orientations—effecting more efficient and less manipulation-intensive placements of both the mesial and distal oriented appliances.

Alternatively, a single tool for use in either orientation may be desired. Such a tool might have actuating portions of a generalized curvature or angle, and might rely on temporary attachment of, for example, grasping assembly **100** for mesial orientation and grasping assembly **200** for distal orientation. In still another alternative embodiment, a tool may comprise actuating portions of adjustable or deformable curvature or angling, allowing a dentist to select his own orientation based on the procedure to be completed.

As an alternative to the bifurcated assemblies described above, the compound actuating assembly of the present invention may be implemented in a variety of stylus-type embodiments. Referring now to FIG. **7**, assembly **700** illustrates one embodiment of a stylus actuating assembly according to the present invention. Assembly **700** comprises a first body member **702** and second body member **704**. Member **704** may be coupled, either internally or externally, to member **702**, within a recessed portion **706** of member **702** by a hinge assembly **708**. A closure mechanism **710** within member **702** is operatively associated with member **704**.

Member **704** is coupled to member **702** close to actuating end **712** of assembly **700**. At end **712**, member **702** terminates in actuating portion **714**. Members of a grasping assembly may be coupled to, or formed as part of, the open ends of member **704** and portion **714**.

As depicted, activation of mechanism **710** will cause member **704** to rotate about hinge **708**, bringing actuating portion **714** and member **704**, and grasping assembly members coupled thereto, together. Thus, grasping assembly members coupled to portion **714** and member **704** are brought together and engaged (i.e., clamped) with increasing force as the force applied by mechanism **710** is increased. Mechanism **710** may comprise a simple, finger-activated, mechanical trigger assembly, an electromechanical solenoid, a pneumatically activated solenoid, or any other similar contrivance enabling a dentist to apply a fixed or progressive range of closing pressures to member **704**. Removing or reversing the closing pressure applied to member **704** will separate member **704** from portion **714**, releasing the grasp of the grasping assembly. Assembly **700** may, optionally, comprise a locking apparatus or assembly of the types previously described, such that mechanism **710**, member **704**, or both may be locked into a desired position.

At end **712**, grasping assembly members may couple to, or be formed as part of, the open ends of portion **714** and member **704**. Portion **714** and member **704** are angled or curved with respect to member **702** to provide an attached grasping assembly proper access to either distal or mesial surfaces, or both. The angles or curvatures of portion **714** and member **704** are matched and aligned to provide proper closure and alignment of grasping assembly members. Again, the curvature or angling of portion **714** and member **704** enables a dentist to place a sectional matrix band in the desired location without manipulating the entire actuating assembly to some extreme angle within a patient's mouth. Depending on whether the coupling of grasping assembly members to portion **714** and member **704** is permanent or temporary, and on whether assembly **700** is intended) to be used for only mesial, only distal, or both mesial and distal orientations, portion **714** and member **704** may be formed with a specific or a general curvature or angling. Again, an alternative embodiment may comprise a substantially straight portion **714** and member **704** where the grasping assembly members are formed with sufficient angling or curvature to facilitate either a mesial or distal orientation.

As an illustration, separate tools for mesial and distal orientations might be desired. Thus, two actuating assemblies would be formed. Each may have grasping assemblies permanently attached thereto. The tool intended for use in mesial orientations would comprise portion **714** and member **704** having a greater degree of curvature or angling than portion **714** and member **704** of the tool intended for distal orientations—effecting more efficient and less manipulation-intensive placements of both the mesial and distal oriented appliances.

Alternatively, a single tool for use in either orientation may be desired. Such a tool might have portion **714** and

member **704** of a generalized curvature or angle, and might rely on temporary attachment of, for example, grasping assembly **100** for mesial orientation and grasping assembly **200** for distal orientation. In still another alternative embodiment, a tool may comprise portion **714** and member **704** of adjustable or deformable curvature or angling, allowing a dentist to select his own orientation based on the procedure to be completed.

Referring now to FIG. **8***a*, another embodiment of a stylus assembly **800** is illustrated. Assembly **800** comprises a first body member **802** and second body member **804**. Members **802** and **804** are inter-connectively coupled together by intermediary member **806**. Actuating members **808** are disposed upon or within member **804**, and are adapted to couple with and actuate members of a grasping assembly (not shown). Members of a grasping assembly may be coupled to, or formed as part of, the open ends of members **808**. Member **806** may provide a conduit from member **802** to member **804** through which a closure mechanism (not shown) may be operatively coupled to members **808**. Such a closure mechanism may comprise any suitable mechanical, electromechanical, or pneumatic contrivance (e.g., pneumatic solenoid) operable to allow a dentist, while handling member **802**, to engage and disengage members **808** as desired. Thus, grasping assembly members coupled to members **808** are brought together and engaged (i.e., clamped) with increasing force as the force applied by the closure mechanism is increased. Removing or reversing the force applied will separate members **808**, releasing the grasp of the grasping assembly.

In addition to, or as an alternative to, serving as a conduit, member **806** may serve as a pivot, about which member **804** may be rotated or otherwise translated, with respect to member **802**, to provide an attached grasping assembly proper access to either distal or mesial surfaces, or both. This is illustrated in FIG. **8***b*, where the rotation of member **804** changes the angle of members **808** with respect to member **802**. In this example, the orientation of FIG. **8***a* might be preferable for mesial procedures and the orientation of FIG. **8***b* might be preferable for distal procedures. Alternatively, or in addition to its rotation, member **804** may be formed with an asymmetry (e.g., quasi-pyramidal or quasi-spherical) such that the rotation of member **804** further enhances bias of assembly **800** to either distal or mesial orientations. In other alternative embodiments, certain members (e.g., member **806**) may be adjustable or deformable with respect to other members to achieve the desired effect. In still other alternative embodiments, multiple rotational and pivotal members of parallel and orthogonal orientation may be utilized to render the desired result. All such embodiments are configured to enable a dentist to place a sectional matrix band in a desired location without manipulating the entire actuating assembly to some extreme angle within a patient's mouth.

Referring now to FIGS. **9***a*–**9***c*, a portion of an assembled instrument **900** according to the present invention is illustrated. Instrument **900** comprises a first actuating member **902** and a second actuating member **904**. Although not shown in FIG. **9***a*, members **902** and **904** are joined together as a single unit at closed end, in a configuration similar to assembly **500** of FIG. **5**. In the alternative, other actuating assemblies in accordance with the present invention may be utilized.

Respectively coupled to, or formed as part of, members **902** and **904** are grasping members **906** and **908**. Transition areas **910** and **912** comprise the regions of co-formation or attachment between members **902** and **906**, and members **904** and **908**, respectively.

Depending upon the configuration of, and the temporary or permanent nature of the connection between, the actuating and grasping assemblies used, transition areas **910** and **912** may be considered part of members **902** and **904**, respectively, or part of members **906** and **908**, respectively, or both. Areas **910** and **912** are angled or curved to facilitate a distal orientation in accordance with present invention, and are aligned to provide proper engagement of members **906** and **908** as described hereafter.

Member **906** is formed having an outer surface **914** and various inner surface features. Along its inner surface, member **906** comprises an apical seating feature **916**. Feature **916** may comprise a ridge, shelf or other contrivance in accordance with the present invention. Feature **916** may protrude slightly from the inner surface of member **916**, or may be flush or contoured therewith. Member **906** further comprises a recessed area **918**, formed adjoined to feature **916**.

Depending upon the specific configuration of member **906**, and of feature **916**, area **918** may be formed as either a straight or curved, single or multi-faceted surface providing access and clearance for engagement between a sectional matrix band and feature **916**. Area **918** may form a well-defined edge along feature **916**, a smooth, rounded edge, or any other suitable transition.

Member **906** terminates with grasping area **920**, which adjoins area **918**. Grasping area **920** is formed with a grasping surface **922** having a concave lateral curvature axis **924**. Grasping surface **922** terminates in outer lateral edges **926**. The lateral curvature of surface **922** is formed, in accordance with the present invention, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In alternative embodiments, angulations may be implemented in place of curvature or curvature may be omitted altogether.

As depicted in FIGS. **9***a*–**9***c*, surface **922** further comprises some longitudinal curvature, orthogonal to axis **924**, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In other embodiments, the longitudinal axis of surface **922** may be substantially straight, or may comprise some angulation to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. Thus, surface **922** may be formed in resemblance to a number of contour profiles (e.g., quasi-spherical, egg-shaped, quasi-conical, quasi-cylindrical, etc.).

Member **908** is formed having an outer surface **928** and various inner surface features. Along its inner surface, member **908** comprises a mating feature **930** and a grasping surface **932**. Feature **930** is formed, in accordance with the present invention, to provide secure engagement in cooperation with feature **916** as described in greater detail hereafter. Feature **930** may comprise a ridge, shelf or other contrivance, and provides a transition from, and demarcation between, region **912** and surface **932**.

Grasping surface **932** has a convex lateral curvature, formed to complement the curvature axis **924** of surface **922**, in accordance with the present invention. The lateral curvature of surface **932** is formed, in accordance with the present invention, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In alternative embodiments, angulations may be implemented in place of curvature or curvature may be omitted altogether.

As depicted in FIGS. **9***a*–**9***c*, surface **932** further comprises some longitudinal curvature, to match or closely approximate the curvature of a sectional matrix band or

other desired dental appliance. In other embodiments, the longitudinal axis of surface **932** may be substantially straight, or may comprise some angulation in accordance with the present invention.

Although the specific embodiments of constituent members may vary slightly, apparatus **900** is generally formed and operable to render members **906** and **908** in pressure-fit, engagable relation to one another while grasping a sectional matrix band between surfaces **922** and **932**. The orientations, curvatures, or angulations of members **902**, **904**, **906**, **908**, **910**, **912**, **916**, **918**, **920**, **922**, **926**, **930**, and **932** are, in this embodiment, formed to facilitate the placement or manipulation of a sectional matrix band in a distal orientation. As actuating members **902** and **904** are brought together, grasping area **920** is brought down into a partially sleeved relationship over feature **930** and surface **932**. Depending upon a user's preference, a sectional matrix band may be positioned in instrument **900** prior to, or just as, area **920** initiates contact with member **908**.

As further pressure is applied to members **902** and **904**, feature **930** slides longitudinally along surface **922** until it enters recess **918** and comes to rest against feature **916**. Surfaces **922** and **932** thus come into pressure fit contact with one another, holding the sectional matrix band stably and securely therebetween. The matrix band is further stabilized and secured, along its upper edge, against feature **916**.

In alternative embodiments, increased grasping pressure may be induced between members **906** and **908** utilizing some locking or fulcrum mechanism in accordance with the present invention, as previously described.

Referring now to FIGS. **10***a*–**10***c*, a portion of an assembled instrument **1000** according to the present invention is illustrated. Instrument **1000** comprises a first actuating member **1002** and a second actuating member **1004**. Although not shown in FIG. **10***a*, members **1002** and **1004** are joined together as a single unit at closed end, in a configuration similar to assembly **500** of FIG. **5**. In the alternative, other actuating assemblies in accordance with the present invention may be utilized.

Respectively coupled to, or formed as part of, members **1002** and **1004** are grasping members **1006** and **1008**. Transition areas **1010** and **1012** comprise the regions of co-formation or attachment between members **1002** and **1006**, and members **1004** and **1008**, respectively.

Depending upon the configuration of, and the temporary or permanent nature of the connection between, the actuating and grasping assemblies used, transition areas **1010** and **1012** may be considered part of members **1002** and **1004**, respectively, or part of members **1006** and **1008**, respectively, or both. Areas **1010** and **1012** are angled or curved to facilitate a mesial orientation in accordance with present invention, and are aligned to provide proper engagement of members **1006** and **1008** as described hereafter.

Member **1006** is formed having an outer surface **1014** and various inner surface features. Along its inner surface, member **1006** comprises an apical seating feature **1016**. Feature **1016** may comprise a ridge, shelf or other contrivance in accordance with the present invention. Feature **1016** may protrude slightly from the inner surface of member **1016**, or may be flush or contoured therewith. Member **1006** further comprises a recessed area **1018**, formed adjoined to feature **1016**. In alternative embodiments, member **1016** may be similarly formed or disposed along the inner surface of member **1008**, as described hereafter in reference to FIG. **11**.

Depending upon the specific configuration of member **1006**, and of feature **1016**, area **1018** may be formed as either a straight or curved, single or multi-faceted surface providing access and clearance for engagement between a sectional matrix band and feature **1016**. Area **1018** may form a well-defined edge along feature **1016**, a smooth rounded edge, or any other suitable transition.

Member **1006** terminates with grasping area **1020**, which adjoins area **1018**. Grasping area **1020** is formed with a grasping surface **1022** having a convex lateral curvature axis **1024**. Grasping surface **1022** terminates in outer lateral edges **1026**. In alternative embodiments, edges **1026** may be omitted, as surface **1022** may have a smoothed transition to surface **1014**. The lateral curvature of surface **1022** is formed, in accordance with the present invention, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In alternative embodiments, angulations may be implemented in place of curvature or curvature may be omitted altogether.

As depicted in FIGS. **10***a*–**10***c*, surface **1022** further comprises some longitudinal curvature, orthogonal to axis **1024**, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In other embodiments, the longitudinal axis of surface **1022** may be substantially straight, or may comprise some angulation to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. Thus, surface **1022** may be formed in resemblance to a number of contour profiles (e.g., quasi-spherical, egg-shaped, quasi-conical, quasi-cylindrical, etc.).

Member **1008** is formed having an outer surface **1028** and various inner surface features. Member **1008** terminates in a mating feature **1030**, formed or adapted to engage with member **1006** in accordance with the present invention. The particular form factor or shape of feature **1030** may vary depending upon the contour of surface **1022**. As depicted in FIG. **10***b*, feature **1030** comprises a saddle-shaped member, comprising a transition feature **1032** and a grasping surface **1034**.

Feature **1032** is formed, in accordance with the present invention, to provide secure engagement in cooperation with feature **1016** as described in greater detail hereafter. Feature **1032** may comprise a ridge, shelf or other contrivance, and provides a transition from, and demarcation between, region **1012** and surface **1034**.

Grasping surface **1034** has a concave lateral curvature, formed to complement the curvature axis **1024** of surface **1022**, in accordance with the present invention. The lateral curvature of surface **1034** is formed, in accordance with the present invention, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In alternative embodiments, angulations may be implemented in place of curvature or curvature may be omitted altogether. As depicted in FIGS. **10***a*–**10***c*, surface **1034** further comprises some longitudinal curvature, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In other embodiments, the longitudinal axis of surface **1034** may be substantially straight, or may comprise some angulation in accordance with the present invention. Furthermore, feature **1030** may comprise outside flange portions **1036**, laterally extending surface **1034** to provide greater lateral support and grasp of a sectional matrix band held within instrument **1000**. In alternative embodiments, however, feature **1030** may be formed having any other suitable topology (e.g., quasi-cylindrical).

Although the specific embodiments of constituent members may vary slightly, apparatus **1000** is generally formed and operable to render members **1006** and **1008** in pressure-fit, engagable relation to one another while grasping a sectional matrix band between surfaces **1022** and **1034**. The orientations, curvatures, or angulations of members **1002**, **1004**, **1006**, **1008**, **1010**, **1012**, **1016**, **1018**, **1020**, **1022**, **1026**, **1030**, **1032**, **1034** and **1036** are, in this embodiment, formed to facilitate the placement or manipulation of a sectional matrix band in a mesial orientation.

As actuating members **1002** and **1004** are brought together, grasping area **1020** is brought longitudinally into feature **1030**, in a partially sleeved relationship with surface **1034**. Depending upon a user's preference, a sectional matrix band may be positioned in instrument **1000** prior to, or just as, area **1020** initiates contact with member **1008**.

As further pressure is applied to members **1002** and **1004**, feature **1030** slides longitudinally along surface **1022** until feature **1032** enters recess **1018** and comes to rest against feature **1016**. Surfaces **1022** and **1034** thus come into pressure fit contact with one another, holding the sectional matrix band stably and securely therebetween. The matrix band is further stabilized and secured, along its upper edge, against feature **1016**.

In alternative embodiments, increased grasping pressure may be induced between members **1006** and **1008** utilizing some locking or fulcrum mechanism in accordance with the present invention, as previously described.

Referring now to FIG. **11**, a portion of an instrument **1100** is depicted. Instrument **1100** represents one alternative embodiment of instrument **1000**, particularly biased for mesial orientation. With certain exceptions described below, constituent members of instrument **1100** are generally identical to those of instrument **1000**. For instrument **1100**, transition area **1010** is angled or curved inward to such an extent that member **1006** forms an angle **1102** with the plane **1104** of member **1002** that is greater than 90 degrees. Further bias for mesial orientation may optionally be provided by inwardly angling or curving grasping area **1020** with respect to the rest of member **1006**. This orientation provides a more optimal mesial bias for instrument **1100**. Depending upon the actuating assembly used, however, this orientation may require a reconfiguration of some features and of the functional and spatial relationship between actuating members **1002** and **1004**.

Referring back to FIGS. **10***a*–**10***c*, member **1006** forms an angle of less than or equal to 90 degrees with respect to the plane of member **1002**. With the configuration of instrument **1000**, members **1006** and **1008** are separated in a nearly-vertical spaced apart relationship in the absence of pressure to members **1002** and **1004**. As closing pressure **1040** is applied to force members **1002** and **1004** together, member **1008** is effectively brought "up" into pressure-fit contact with member **1006** as previously described. Thus, instrument **1000** is "open" when no pressure **1040** is applied.

In contrast, the greater mesial bias of instrument **1100** renders such relationship physically impossible for many actuating apparatus. Instrument **1100** therefore alters the the functional and spatial relationship of actuating members **1002** and **1004** to render them "open" when pressure **1106** is applied, and "closed" in the absence of pressure **1106**.

In instrument **1100**, member **1008** is formed having an apical seating feature **1108**. Feature **1108** may comprise a ridge, shelf or other contrivance in accordance with the present invention. Feature **1108** may protrude slightly from the inner surface of member **1008**, or may be flush or contoured therewith. Feature **1108** adjoins the upper perimeter of mating feature **1030**.

Again, grasping area **1020** is formed with a grasping surface **1022** having a convex lateral curvature axis. Grasping surface **1022** may terminate in outer lateral edges **1026**. The lateral curvature of surface **1022** is formed, in accordance with the present invention, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In alternative embodiments, angulations may be implemented in place of curvature or curvature may be omitted altogether.

As depicted in FIG. **11**, surface **1022** further comprises some longitudinal curvature, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In other embodiments, the longitudinal axis of surface **1022** may be substantially straight, or may comprise some angulation to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. Again, surface **1022** may be formed in resemblance to a number of contour profiles (e.g., quasi-spherical, egg-shaped, quasi-conical, quasi-cylindrical, etc.).

Member **1008** terminates in a mating feature **1030**, formed or adapted to engage with member **1006** in accordance with the present invention. The particular form factor or shape of feature **1030** may vary depending upon the contour of surface **1022**. As depicted in FIG. **11**, feature **1030** comprises a saddle-shaped member with grasping surface **1034**.

Grasping surface **1034** has a concave lateral curvature, formed to complement the curvature axis of surface **1022**, in accordance with the present invention. The lateral curvature of surface **1034** is formed, in accordance with the present invention, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In alternative embodiments, angulations may be implemented in place of curvature, or curvature may be omitted altogether. As depicted in FIG. **11**, surface **1034** further comprises some longitudinal curvature, to match or closely approximate the curvature of a sectional matrix band or other desired dental appliance. In other embodiments, the longitudinal axis of surface **1034** may be substantially straight, or may comprise some angulation in accordance with the present invention. Feature **1030** may comprise outside flange portions, or may be formed having any other suitable topology (e.g., quasi-cylindrical).

Although the specific embodiments of constituent members may vary slightly, apparatus **1100** is generally formed and operable to render members **1006** and **1008** in pressure-fit, engagable relation to one another while grasping a sectional matrix band between surfaces **1022** and **1034**. The orientations, curvatures, or angulations of member are, as previously noted, formed to particularly bias the instrument in a mesial orientation.

In the presence of actuating pressure **1106**, actuating members **1002** and **1004** are brought together, "opening" and disengaging members **1006** and **1008**. When "opened", member **1008** separates from member **1006** in a nearly-vertical spaced apart relationship, where member **1008** is above member **1006**. The inner surface of member **1008** may rest in contact with the inner surface of member **1006**, or it may be slightly spaced apart therefrom. During operation of instrument **1100**, either or both members **1006** and **1008** may deform slightly to allow closure in accordance with the present description. As opening pressure **1106** is decreased, separating members **1002** and **1004**, member **1008** is forced "down" into pressure-fit contact with member **1006**.

Thus, instrument **1100** is "open" when pressure **1106** is applied. As actuating members **1002** and **1004** are released, grasping area **1020** is brought longitudinally into feature **1030**, in a partially sleeved relationship with surface **1034**. Depending upon a user's preference, a sectional matrix band may be positioned in instrument **1000** prior to, or just as, area **1020** initiates contact with member **1008**. As pressure **1106** is completely eliminated, feature **1030** slides longitudinally along surface **1022** until it comes to rest, in full pressure fit contact with surface **1022**, holding the sectional matrix band stably and securely therebetween. The matrix band is further stabilized and secured, along its upper edge, against feature **1016**.

In alternative embodiments, increased grasping pressure may be induced between members **1006** and **1008** utilizing some locking or fulcrum mechanism in accordance with the present invention, as previously described.

For all embodiments, selection of materials for formation of the assemblies will depend on a number of factors. In all cases, materials selected must be durable enough to withstand the pressures (e.g., grasping, closing, pulling) applied throughout the system during a procedure. Furthermore, the materials utilized should be malleable enough to be formed into the desired shapes and orientations. If an embodiment requires a deformable member, the material used to form that member should be flexible enough to provide the desired deformation while remaining durable enough to withstand the pressures applied.

If an assembly or a sub-portion thereof is intended to be of a disposable, one-use nature, then a reliable but inexpensive material (e.g., plastic) may be used in production. If an assembly or a member is intended to be of a re-usable nature, then a durable material (e.g., stainless steel), capable of withstanding repeated sterilization procedures, may be used in production.

The embodiments and examples set forth herein are presented to best explain the present invention and its practical application and to thereby enable those skilled in the art to make and utilize the invention. However, those skilled in the art will recognize that the foregoing description and examples have been presented for the purpose of illustration and example only. The description as set forth is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching without departing from the spirit and scope of the following claims.

What is claimed is:

1. A dental instrument biased toward a mesial or distal orientation, the instrument comprising:

an actuating assembly having first and second actuating members;

a first grasping member, coupled to the first actuating member at a first transition area, having a first grasping surface formed, proximate to the first transition area, with a first contour; and

a second grasping member, coupled to the second actuating member at a second transition area, having a second grasping surface formed, proximate to the second transition area, with a second contour.

2. The instrument of claim **1**, wherein the instrument is biased exclusively toward a mesial orientation.

3. The instrument of claim **2**, wherein the first and second contours comprise a lateral curvature.

4. The instrument of claim **2**, wherein the first and second contours comprise a longitudinal curvature.

5. The instrument of claim **2**, wherein the first and second contours comprise a lateral angulation.

6. The instrument of claim **2**, wherein the first and second contours comprise a longitudinal angulation.

7. The instrument of claim **1**, wherein the instrument is biased exclusively toward a distal orientation.

8. The instrument of claim **7**, wherein the first and second contours comprise a lateral curvature.

9. The instrument of claim **7**, wherein the first and second contours comprise a longitudinal curvature.

10. The instrument of claim **7**, wherein the first and second contours comprise a lateral angulation.

11. The instrument of claim **7**, wherein the first and second contours comprise a longitudinal angulation.

12. The instrument of claim **1**, wherein the actuating assembly comprises a bifurcated assembly.

13. The instrument of claim **1**, wherein the actuating assembly comprises a stylus assembly.

14. An instrument for mesial manipulation of a matrix band, comprising:

an actuating assembly, having first and second actuating members;

a first grasping member, coupled to the first actuating member at a first transition area, having a convex grasping surface formed proximal to the first transition area;

a second grasping member, coupled to the second actuating member at a second transition area, having an apical seating feature formed proximal to the second transition area, having a concave grasping surface formed proximal to the apical seating feature;

wherein the actuating assembly is operable to engage the convex and concave grasping surfaces in a pressure fit relationship.

15. An instrument for distal manipulation of a matrix band, comprising:

an actuating assembly, having first and second actuating members;

a first grasping member, coupled to the first actuating member at a first transition area, having an apical seating feature formed proximal to the first transition area and having a concave grasping surface formed proximal to the apical seating feature;

a second grasping member, coupled to the second actuating member at a second transition area, having a mating feature formed proximal to the second transition area and having a convex grasping surface formed proximal to the mating feature;

wherein the actuating assembly is operable to engage the convex and concave grasping surfaces in a pressure fit relationship.

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